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28 June 1982

# WEST EUROPE REPORT SCIENCE AND TECHNOLOGY

No. 108

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## ELECTRONICS

### MICROELECTRONICS PLAN: WIN MARKET, TECHNOLOGY INDEPENDENCE

Paris L'USINE NOUVELLE in French 18 Mar 82 p 55

[Article by Daniel Lacotte: "The Two Gambles of the Second Components Plan"]

[Text] The administration has just announced important measures to promote the French integrated circuits industry. Without changing the structure of the Components Plan launched in 1978, the government has announced the basic outlines of the action which it intends to take between now and 1986: on the one hand, winning back the French market; on the other, attaining true independence with respect to integrated circuit design.

On the first point, the government has not yet reached a decision as to the aid to be granted to manufacturers in order for their production to cover the French market in 1986. On the second point, the minister of industry estimates that Fr 3.4 billion will have to be invested in research and development over a 5-year period. A budget of Fr 480 million is planned for 1982 as of this writing. In any event, the administration has set the rules of the game: one-third of the investments is to be made by the manufacturers.

#### Two Centers for Classic Circuits, Three for MOS

The French components industry will thus retain the industrial structure established by the 1978-1982 Five-Year Plan, namely: two centers for classic circuits--Radiotechnique-Compelec (a Phillips affiliate) for bipolar circuits and Thomson for linear circuits, but principally three centers for MOS [mercury-oxide semiconductor] circuits, which represent 50 percent of the world market.

With respect to MOS circuits (strategic components for the future), the authorities decided in 1978 to build French production on American technology. Thus, Matra is associated with Harris, and Saint-Gobain with National Semiconductor (in a common affiliate, Eurotechnique). Finally, the third MOS center is EFCIS, whose stockholders are Thomson and the AEC. Each firm has a plant (Nantes for Matra-Harris; Rousset, near Marseille, for Eurotechnique; and Grenoble for EFCIS) that started production at the beginning of last year.

La Dieli, the official entrusted with the electronics and computer industries in the Ministry of Industry, confirms that "the alliances with our American partners will be maintained," and she estimates that present production capacities

and plans for developing the three plants between now and 1986 will represent Fr 2.3 billion in turnover in 5 years. At this time, the French integrated circuits market is estimated at Fr 4.5 billion. The conclusion of the Ministry of Industry: In order to win over this French market, the three other plants must produce more in order to make up the difference--i.e., Fr 2.2 billion. Now it is known that in electronics, "in order to get one franc of turnover, one franc has to be invested."

Consequently, in order for French production in 1986 to be able to cover the domestic market, the manufactueres are going to have to invest an additional Fr 2.2 billion--a large sum for which the administration and the manufacturers, which have just passed into the public sector, will both assume responsibility. For the immediate future, nothing has yet been determined as to the distribution of aid to the three groups.

#### Stemming the American and Japanese Monopoly

There is still the problem of research. In the 1978-1982 plan, public credits were increased to Fr 600 million. This was not enough to attain adequate production volume and at the same time launch constructive research in future technologies. The government is contributing part of the answer, since it will encourage manufacturers to invest one-third of the Fr 3.4 billion necessary for France to have true technological independence in 1986. And the state would thus be ready to pay the remaining two-thirds. "It's a big bill, but independence comes at such a price," La Dieli is told, "that it is ardently hoped Matra-Harris, Thomson (EFCIS) and Eurotechnique (Saint-Gobain) will play ball."

Up to now, over the 1978-1982 period Matra-Harris has invested Fr 200 million, Eurotechnique Fr 420 million, and EFCIS Fr 670 million (including Fr 223 million of public aid), for a total of Fr 1.3 billion. The three groups will have to work in double quicktime in the coming 5 years. And this is precisely the gamble of this second Components Plan: Will each of the three partners have the necessary industrial determination to stem the American and Japanese monopoly in the sector?

#### An Intermediate Solution for Eurotechnique

The launching of this second plan brings up again the problem of Eurotechnique. Will it try to merge the Saint-Gobain affiliate and EFCIS? At the Ministry of Research and Technology, this eventuality is considered a "folly." It is felt that the three centers originally established should instead be retained. But there are two ways of retraining them. For Eurotechnique, it is a question of knowing whether it will remain within Saint-Gobain's domain or if it will be detached from it. The administration is moving toward a median solution: Eurotechnique would continue to belong to the Saint-Gobain group but would no longer be controlled by it. The group's reaction: "It is out of the question; we want to control all the operations or none at all!"

At the start of this new Components Plan, it is no exaggeration to state that the 1978-1982 plan made it possible for the three French plants to prove mass production was possible, even if the 1981 results remain modest (production capacity was Fr 1.1-1.5 billion, while real production did not exceed Fr 500 million). Success will be conditioned by rigorous planning of public aid and the objectives to be fulfilled for each of the centers. It will also depend on the groups, and on the willingness of the men heading them to take up the bet.

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CSO: 3102/217

## ELECTRONICS

### COMMENTARY ON NEW MICROELECTRONICS PLAN

Paris LE NOUVEL ECONOMISTE in French 22 Mar 82 pp 66-67

[Article by Anne-Marie Rocco: "Components, Six Billion for Chips"]

[Text] Ambitious at the national level, modest at the international one. If the objectives of the new integrated circuits plan are known, its details and approaches will not be disclosed before July. One thing is certain: between now and 1986, the industrialists will have to invest 6 billion francs.

Industrial plans pass but the problems remain. At least that is the case for microelectronics. In 1978, the government had launched a vast operation designed to create, almost from scratch, a French integrated circuits industry, these being the components used as raw material by the entire electronics sector. The year of transition is 1982: one plan ends, another begins. The French production remains insufficient and the trade deficit for integrated circuits is very high: 600 million francs in 1981. Pierre Dreyfus, minister of industry, has just presented to the Council of Ministers the broad outlines of the new effort to be undertaken. The details and concrete ways and means will not be known before the beginning of July. But two objectives have been set: reduce the number of industrial orientations involved, and multiply by nine the value of French production between now and 1986.

The integrated circuits plan of the previous government relied on no less than five industrial groups, to the despair of some of the participants, who would have preferred a more restricted competition. Among them were three already existing enterprises: Efcis, subsidiary of Thomson-CSF and CEA; the Integrated Circuits Division (DCI) of Thomson-CSF; and Radiotechnique Compelec (RTC), subsidiary of the Dutch group Philips. Two other forces were created from the ground up: Matra-Harris Semiconductors (MHS), and Eurotechnique, steered by Saint-Gobain. Except for RTC, all these groupings relied on collaboration with American enterprises which had the necessary technology: license agreements with Motorola for Efcis and DCI, Harris participation in MHS's capital, and National Semiconductors investment in Eurotechnique's capital.

Overall, 1.2 billion francs were spent to create these nodes and strengthen existing structures, 700 million of which came from government loans and subsidies. Compared to the admission price to the electronics scene, the results obtained in 1981 remain modest. Eliminating, from the turnover of the five enterprises concerned, the part



which is pure trading, French production barely amounts to 500 million francs in a world market of 70 billion. It is true that the two new enterprises have only recently begun their activities; production at Eurotechnique for instance, did not start until last summer. The industrial capability of the five groups should in fact be 2-3 times higher than the 1981 production.

#### Balance

It will however, be necessary to take longer strides. "Considering the future investments that have already been approved and programmed until 1984, French production should normally reach 2.2 billion francs in 1986," explains Jean-Claude Hirel, director for the electronics industry and computers at the Ministry of Industry. Given the evaluation of the future needs of the user industries--from the telephone to data processing, going through toys, household appliances, and automobiles--this production would be inadequate to regain the equilibrium of the balance of trade. The government therefore decided to raise the hurdle and set the production volume desired for 1986 at 4.4 billion.

Ambitious on a French scale, and modest at an international level, this objective implies in any case a considerable increase in financial effort. "Because," the explanation goes, "in this industry it is today necessary to invest one franc in order to obtain an additional franc in turnover." Logically, this means that between now and 1986 the industrialists will have to invest another 2.2 billion francs in order to increase their production capability. But the Ministry of Industry estimates that they will also have to devote 3.4 billion francs to research and development during the same period. Which means a total of nearly 6 billion francs in five years.

For 1982, the government's participation in this plan will be 480 million francs for research and development, and the public agencies will be able to release up to 340 million francs in discounted loans to finance industrial investment. But the overall coverage of the plan has not yet been set, nor have the beneficiaries been designated. And for good reason.

#### Agreements

No one yet knows the industrial structures on which the plan will rest. The administration's major concern is apparently to reduce the number of production nodes. It is true that in a depressed international market, and given the current cost of investments in this industry, technologic and industrial alliances between competitors are multiplying, in Japan as well as in the United States. Why should the French enterprises, already handicapped by a tight national market and a late start, insist on dispersing themselves? The argument has some logic. A first step in this direction will soon be taken. Efcis and DCI, who already are using a common sales network and a joint administration under the leadership of Paul Mirat, will come progressively closer, aiming at a merger. Their case is a simple one to solve, since they depend on the same industrial group, Thomson-CSF, and since their association with the American company Motorola is limited to licence agreements.

For MHS and Eurotechnique, in which American groups hold nearly one-half of the capital, and for RTC, a multinational subsidiary, the problem will be more complex. Will it be possible to reduce to less than four the number of industrial nodes covered by the integrated circuits plan? The government appears to wish it, while at the same time stating that it will allow the continuation of existing associations; and that it will in no way seek to reduce the participation of foreign partners in French enterprises. How will it square the circle? The answer will be known at the beginning of the summer.

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## ELECTRONICS

### INTEGRATED CIRCUITS PLAN EXPANDED TO ALL MICROELECTRONICS

#### Plan Outlined

Paris ELECTRONIQUE ACTUALITES in French 12 Mar 82 pp 1, 11

[Article by J. P. Della Mussia]

[Text] According to a communique of the Council of Ministers session of last Thursday, the government is going to officially continue its aid to the French integrated circuits industry, and is even going to extend it to the field of microelectronics as a whole, that is, not only silicon integrated circuits, but also machines that manufacture them, materials, GaAs circuits, bubble memories, low temperature circuits, and "custom development."

The financial backing for this microelectronics plan, for the year 1982 alone, amounts to 480 MF for research and development, and 340 MF for investment. Another financial package is under study for the 1983-1986 period.

The government emphasizes that this financial support will be complemented by "an optimization of industrial structures made possible by extension of the public sector," but no details are given about this optimization, for the simple reason that the ministry of industry is still at the stage of theories, and that the new heads of the nationalized enterprises are not yet possessed of all the pertinent data to adopt changes which could prove to be important.

#### More Than 6000 MF to Be Invested Over Five Years

In this connection, the communique specifies that the Interministerial Group for Integrated Circuits (GICI, responsible for the inception of the first integrated circuits plan, as well as the new microelectronics plan) "will submit, before 1 July of this year, its proposals for the goals and requirements of each concerned enterprise, the eventual structure modifications necessary for optimum utilization of industrial resources, as well as the means to be implemented for training the engineers and technicians who will be needed for the development and implementation of microelectronics."

According to another, non-public document issued by the Ministry of Industry for the use of various interested ministries, attention should also be devoted to formulating a plan that would cover all electronic components in general. The

document also stipulates that "it would be desirable to achieve, within five years if possible, a balance of trade equilibrium for French microelectronics." According to this document, this objective should require on the part of industry and public agencies (which therefore does not mean aid), a total industrial investment effort of more than 2 billion francs between 1982 and 1986--in fact more than 3 billion overall, when the actions already planned for that period are included--and a total research and development effort of 3 billion francs as well.

The government contribution toward the achievement of this objective is not yet defined. In particular, it could partially come in the form of capital increases for nationalized companies. Given the current structure of the French microelectronic industry, one can in any case expect that 80 percent of the announced sums would come either from the government, or from nationalized companies, with the remaining 20 percent coming from the private sector. As a guideline, according to official ministry studies (which we believe are exaggerated), two-thirds of the country's research and development effort before the nationalizations was supported by the government (DIELI and DGRST provide up to 50 percent of support for studies, and telecommunications and the army pay 100 percent of some others); as for industrial investments, the government support was of the order of 40 percent before the nationalizations.

Whatever the case may be, the microelectronic plan for the 1983-1986 period should be finalized by 1 July of this year. The needs will be defined by GICI, but the sources of financing and final decisions will remain under the responsibility of the Prime-Minister.

#### Redoubled Effort

The 480 MF + 340 MF announced for 1982 appear very large at first sight, when compared to the government financing of the first integrated circuit plan for 1978-1981, which--in 1982 value and with additions made during the plan--finally amounted to 1200 MF (an average of 240 MF per year). But the first plan was aimed solely at integrated circuits and not microelectronics in general. Actually, the ministries of industry (DIELI), research (ex-DGRST), armed forces (mainly DRET), and telecommunications (DA II), have always supported microelectronics activities other than integrated circuits, but without the existence of an official joint action and budget as part of a plan, as in the present case. However, comparisons can still be made for integrated circuits alone: for 1982, the government has planned a financing of 240 MF for research and development in this field, and 300 MF for industrial investments. The announced amounts do not include the financing undertaken in June 1981 for the MHS/Intel operation, among other things. On the other hand, the 240 MF for research and development include 1982 extensions of the first integrated circuit plan, to wit: 18 MF for Thomson/DCI, 45 MF for EFCIS, 21 MF for RTC/LEP, 5.8 MF for Eurotechnique, and 5.8 MF for MHS (the two latter entries also covering a small amount for investments), or a total of 95 MF (including taxes) to be subtracted from the above-mentioned 240 MF for assessing the new allocated credits.

The overall annual increase in the effort is nevertheless considerable, if one takes into account the investment aid.

The other research and development credits will be assigned to fabrication machines for integrated circuits (55 MF), bubble memories (20 MF in reserve), gallium arsenide microelectronics (70 MF outside of discrete devices), low temperature circuits (20 MF), materials other than silicon and GsAs (15 MF), and custom development (60 MF). The two latter categories will help, through specific actions, industries that are currently ill-prepared for electronics, such as toys and household electronics for instance. In principle, they will benefit small and medium-sized enterprises and industries.

For industrial investments, 30 MF are planned for machines and 10 MF (in reserve) for bubble memories, in addition to the 300 MF for integrated circuits.

Neither the distribution of these credits among companies, nor their objects are disclosed at this time. But it is clear that the 20 MF + 10 MF stipulated for bubble memories are intended for SAGEM, if this company undertakes industrial production in order to become second source for Intel or Motorola. Everything therefore depends on the results of SAGEM's current negotiations.

#### More Precise Objectives

Beyond the figures already indicated, the objectives of the new actions differ from those of the first integrated circuits plan. It might be remembered that the plan's purpose was essentially to maintain the French systems know-how in France; at the time, the success of custom integrated circuits in particular, had caused a drain of ideas toward the United States, where the specialists on custom integrated circuits could be found. Another goal of the first plan was to implant an integrated circuit industry in France, so that our systems industries would not suffer from shortages during periods of high demand. These objectives have been achieved; the new plan will therefore complete them. In its microelectronic features in general, not only does it tend to bolster the country's independence in several strategic domains--particularly for fabrication machines--but it also would allow France to retake the offensive in the advanced circuit arena throughout the world. In fact, the establishment of a "custom development" classification marks the beginning of a global approach to the problem, which will guide the 1983-1986 plan. It will not come as a surprise to find in the latter such classifications as "marketing" or "implantation of sales networks" for instance. Specific product objectives will also be defined, but so will their total costs, knowing that for a family of products, a company currently needs to cover at least 5 percent of the world market to survive, and 10 percent to live.

#### More Details Furnished

Paris ELECTRONIQUE ACTUALITES in French 19 Mar 82 p 15

[Article by J. P. Della Mussia]

[Text] Following the announcement of the Microelectronics Plan (see ELECTRONIQUE ACTUALITES, 12 March 1982), DIELI and GICI provided further details on 10 March, during a press conference about its implementation, both for this year and for the 1983-1986 period.

Among the comments made on this occasion, the authors of the plan clearly expressed their opinion about the structure of the French industry: "Five areas are currently being supported; we want to reduce this number. It's up to the enterprises to voice their opinions." About Eurotechnique, they said: "For the time being, Saint-Gobain remains in Eurotechnique's capital; however, the question of Eurotechnique's management remains to be discussed."

In particular, it is envisaged that this management will be turned over neither to Saint-Gobain, nor to Machines Bull, but perhaps to Thomson.

#### 4000 MF Worth of Integrated Circuits in 1986

We will subsequently attempt to summarize the advantages and disadvantages of eventual structural changes. For the moment, we only regret that they have not been specified: "It's up to the users to give us their opinion." After all, microelectronics is not an end in itself. The objective of a microelectronics plan should lead to the achievement of the best possible electronic systems, so that France may be in an exporting position in this area; the plan must therefore be drawn first of all for microelectronics users. It is fifteen times better to bring the country's export/import balance for electronics systems to 100-110 percent thanks to good components (turnover of the electronics branch is about 95,800 MF), than to bring the semiconductor balance to 80-100 percent (semiconductors turnover is about 3000 MF, including companies that are not "supported").

For the same reason, the objective claimed by the government "to reach a balance of trade in microelectronics for the 1983-1986 period," should not be advanced as a priority objective. What is important, in our opinion, is rather to have a microelectronics industry that is sufficiently healthy to respond to the needs of electronics systems industries for innovation and rapid response. If in addition to that (or because of it), our balance of trade must reach equilibrium for microelectronics, that much the better. But that is not obvious on the face of it. At a French-German level on the other hand, and eventually expandable to other European countries, a trade balance equilibrium could be conceived to counterbalance the American and Japanese forces.

Except for this remark, GICI approached the problem of the microelectronics industry in a realistic manner.

In order to lay the foundations of a French microelectronics industry, the first integrated circuits plan had outlined a financial effort on the part of the government, of the same order of magnitude (per inhabitant) as that of the countries most involved in this field. Now that this industry does exist, it should not be a follower, but rather should have its own position on the world scene. The financial reference must therefore change. GICI approached the problem in two ways; in both, the conclusion was the same: the present effort must be doubled.

First approach: a critical threshold exists for the success of an industry. According to GICI studies, this threshold will be reached only if the turnover of the French microelectronics industry reaches 4000 MF in 1986, which is double the amount forecast at the time of the first integrated circuit plan.

Second approach: the French systems market should absorb the turnover equivalent of the French microelectronics industry if our balance of trade has reached an equilibrium in microelectronics by 1986. It so happens that our electronics industry will then need 4000 MF worth of integrated circuits. (GICI does not seem to take into account the turnover of non-supported companies, which will not remain inactive, such as TI or Motorola).

It is based on this goal that GICI calculated that between 1982 and 1986 it would be necessary to invest 2200 MF more than anticipated (meaning a total of 3200 MF), and to devote 3400 MF to research and development during the same period (see our previous issue). At the same time, the yearly shortfall of specialized engineers and technicians was estimated to be 400 people.

Will the American companies associated with some French companies accept to reinvest in the joint ventures created in France? GICI's response is that "this will be the subject of negotiations until 1 July, and could lead to structure modifications." Whatever the case, collaborations abroad should be pursued or expanded if they prove to be desirable.

#### 90 MF Over Five Years for Mass Bubble Memories

Many other clarifications were also offered by GICI about the new microelectronics plan. First of all, the 2200 MF of additional investment between 1982 and 1986 will be distributed as follows: 1900 MF for integrated circuits, 170 MF for machines, and 90 MF for bubble memories. (Involvement in a bubble memory activity is desirable because "the game is worth the candle"). The companies supported by the first integrated circuits plan will have produced a turnover of 500 MF during this year. And the 480 MF released for research and development in 1982 come from the following sources: 230 MF from the Ministry of Industry, 90 MF from PTT, 100 MF from the Ministry of Defense, and 60 MF from the Ministry of Research and Technology.

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## ELECTRONICS

### UNIVERSITY DEVELOPS COMPUTER-DESIGNED SEMICONDUCTORS

Duesseldorf VDI NACHRICHTEN in German 9 Apr 82 p 1

[Article: "Computer Developed Microprocessors"]

[Text] A program for semiconductor design developed and delivered to the customer by coworkers at Chair I for Information Theory at the University of Dortmund consists of about 50,000 lines written in the computer language Pascal. According to university information sources, this is one of the first computer design systems developed in the FRG at a university for practical application in industry and is among the very few such developments worldwide.

Highly integrated semiconductor circuits for electrical and electronic devices--chips with up to 60,000 transistors on an area of 0.5 to 1.0 cm<sup>2</sup>--present their designers with special problems: Due to their complexity, the circuits cannot be completely represented graphically nor built as experimental prototypes. In the future these designs will proceed faster and easier with the computer design system conceived at Chair I for Information Theory at the University of Dortmund (Prof Dr Bernd Reusch) under the direction of Dr Franz-Josef Ramming. The work was accomplished under contract for Siemens.

The program recently delivered to the customer is part of a larger research project which has been pursued by coworkers of Chair I for 7 years. In this project and follow-on developments, the computer will be used to support design work which is no longer tractable by conventional methods. In this the design will be described in various levels of abstraction with formal mathematical languages, and the desired circuits will be simulated. To achieve this a special design language including syntax and semantics was developed for the computer. A compiler translates these statements and symbols into the internal machine languages of commercial computers, and finally, a simulator makes it possible to execute the functions.

From this development the Dortmund scientists promise a significant reduction in development times for highly integrated circuits. The engineer will describe the chip he wants to build in the expanded mathematical language of the computer. The designs can be defined as a function of the



objectives to be accomplished and prototypes can be built and tested, at least in the computer even if not in reality.

Until now the integration of chips has been relatively expensive due to their time consuming design. With the use of electronic design systems, this time can be shortened significantly, and the cost of chips reduced. Also, it will become possible to produce chips economically for special purposes in smaller lots and to further increase their performance.

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## ELECTRONICS

### BRIEFS

SIEMENS FLAT-PANEL DISPLAY--Siemens is presently working on a picture screen which will combine the advantages of the CRT (high resolution, color pictures) and the plasma display (flat construction), according to a Siemens report. The voluminous glass tube is replaced by a flat plasma-filled pan with a front cover of flat glass plate. Flat cold cathodes on the bottom of the pan produce the gas discharge which serves as the electron source. Beyond a plate with anodic lines and control slots adjoins an acceleration space for the emitted electrons whose trajectories measure only 1 mm. The inside of the front plate can be covered with phosphorous points for all colors. The resulting overall thickness is only 6 cm. Presently Siemens has a prototype for data display equipment which can present 28 lines of 80 characters each. The diagonal of the picture display measures 14 inches. [Text] [Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 18 May 82 p 5] 9160

CSO: 3102/291

## ENERGY

### EC PUBLISHES REPORT ON 'PHOTOVOLTAIC POWER FOR EUROPE'

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 26 May 82 p 5

[Text] Frankfurt, 25 May --In the year 2000, European manufacturers of solar cells will produce enough cells yearly to be able to generate 1,000 Mw of electric energy annually. This corresponds to the output capacity of a medium nuclear power plant. This is the essence of a study by the EC soon to be published under the title "Photovoltaic Power for Europe" on which the THE FINANCIAL TIMES reported briefly on 17 May.

The study's results were presented at the solar energy conference held early in May by the EC in Stresa, Italy. A British corporation consultant company had prepared the study for the Commission. According to these results, by the year 2025 European countries will have installed solar energy power plants with a capacity of 200,000 Mw and they will supply 10 percent of the European electric energy requirements.

The 600 delegates from 30 countries however heard a warning to the effect that these statistics would apply only if the solar cell industry were to continue to get massive support from the governments and public institutions, last but not least, also from the Commission itself. Without this kind of support, solar cell and module production would remain far below the figures given in the study. So far, the government, the public institutions and enterprises have spent \$1 billion to promote solar cell research and to develop and test the product. The study demanded that these subsidies be increased considerably in order to improve the pertinent technologies, to cut the costs, and to open up markets for the products.

The EC so far has paid out about \$30 million in subsidies and is planning a massive increase in the context of the next 3-year budget. Italy likewise has recognized the enormous potential of renewable energy sources, particularly solar cells. The government in Rome approved a budget allocation of 3 billion lire for the period of 1982-1984 in support of the recently formed ENEALIN (National Agency for Alternate Energies). Furthermore, 20 percent of this sum are earmarked for solar cell research. According to the study, Italy has all of the prerequisites for an efficient solar cell industry. It not only has public institutions which readily invest considerable amounts in solar cell technology but it also has a sunny climate plus 70,000 residential dwellings in

underdeveloped areas which are not at all connected to the electric power supply grid at this time. These regions are supplied with electric current only by small diesel generators which supply electric power at costs ranging up to DM1.20 per kwh, converted. That is more expensive than the energy which can be delivered with present-day solar cell systems.

But the costs of the solar cell system are declining gradually. So long as financial support can be maintained at the present level, the study's authors cannot see any reason why the cost could not be reduced to \$5 per peak-load watt by 1990 and to \$1.6-3.5 per peak-load watt by the end of the century. In view of such cost reductions, the authors conclude that, by 1995, each year about 100,000 solar cell units in the output range around 50 w can be installed for small-scale users throughout Europe. Systems of similar magnitude for navigation aids, for communications, and for cathode corrosion protection would come to an annual installation rate of 50,000 units. The growth of these small systems which are independent of the grid should add up to about 12 Mw per year by 1995.

In the area of larger systems, likewise independent of the grid, in the output range of around 5 kw, to replace smaller diesel generators, about 4,000 units will be installed by 1990 according to the study and from then on, an average of 8,000 units will be installed each year until 1995. Around 1995 accordingly the installation rate will be something like 40 Mw annually. In both sectors however the market penetration in view of the authors will reach its high point at these levels and the installation rates will then level off.

The situation is entirely different in the case of large industrial or solar power plant systems connected to a supply grid. The authors believe that solar energy will penetrate these sectors only from 1995 on. Until the year 2000, grid-dependent systems, with a capacity of up to 25 kw to supply residential areas, will be built at a rate of 800 Mw per year. According to the study, the figure would appear to be 2,000 Mw each year by 2025.

In industry, where systems with an average capacity of 100 kw are being installed, a total capacity of 1,000 Mw from solar cells will be achieved by the end of the century according to these forecasts. Power plants still need considerably greater capacities on the order of 200 Mw. As the projections show, large-scale solar cell systems, with a total capacity of about 50,000 Mw, will have been installed for electric power supply grids by the year 2025. But a major increase in these installations will start only in 2000. If we start with a basic installation rate of 1 Mw, which will be attained in 1983, we can figure on a growth rate of about 50 percent and the annual increase accordingly by the end of the century will be 1,000 Mw. If this development continues unhindered during the first two decades of the 21st century, then Europe will, by 2025, be able to have 200,000 Mw from solar cells and that comes to 10 percent of electric power requirement of the EC.

Because sales of solar cells in the rest of the world are many times greater than in Europe, the study starts with an annual world market sales volume of \$5-10 billion around the year 2000. The Commission now wants to do everything to make sure that the European solar cell industry will be able to cope with the anticipated enormous increase. For this purpose it launched a program

last year for the presentation of large-scale projects. Originally, the intention was to provide partial financing for the construction of 19 solar cell generators with a total capacity of 1.3 Mw of which at least one would be built in each member country.

Political, technical, and financing problems forced the Commission to scale these plans back. According to the latest status, 17 generators are now to be built in nine out of the ten member countries. The only country in the EC not considered in the program is Denmark. The first of these 17 generators is to be placed in operation in June on Crete. The other projects will be completed by June 1983. In spite of the start-up difficulties, the Mission is confident that 17 generators will be the forerunners of hundreds of larger plants in the output capacity range from 100 kw on up. The report entitled "Photovoltaic Power for Europe" will soon be published by D. Reidel Publishing, P.O. Box 17, 3300 AA Dordrecht, the Netherlands.

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## ENERGY

### FRG, AUSTRALIA COAL LIQUEFACTION STUDY: RESULTS

Duesseldorf CHEMISCHE INDUSTRIE in German Apr 82 pp 222-223

[Article by Ernst Koch: "Getting Liquid Fuels Economically from Coal"]

[Text] Early in 1979, the Federal Ministry of Research and Technology in Bonn and the Australian DNDE (Department for National Development and Energy) in Canberra awarded a study contract to a German consortium under the direction of Imhausen-Chemie GmbH [Incorporated] to investigate Australian coal--from the federal states of New South Wales (NSW), Queensland, and Victoria--to make liquid fuels. This so-called Imhausen Study was delivered to the customers on 31 August 1981, right on schedule. The study was presented in Canberra, Australia, on 16 November 1981. The following attended: Representatives from the Australian federal government, representatives from the German federal government, representatives from the governments of the Australian federal states of New South Wales, Queensland, and Victoria, and representatives of the Australian organizations and German firms responsible for the study (see also "Imhausen Study Delivered to Australia," CHEM. IND., 12, 1981, p 757). In the following we present extracts and summarized results of the economic feasibility calculations which were prepared in each case for the construction and operation of a plant for the liquefaction of hard coal and the procurement of carburetor fuel, diesel fuel, and liquid gas in the Australian federal states of NSW and Queensland as well as for the erection and construction of a plant to produce engine fuels from brown coal in the federal state of Victoria.

The basis for the feasibility study is an optimization study, completed in December 1978, in which 11 combinations of methods for the conversion of coal into engine fuels were compared. This optimization study led to the result that the combination of a Fischer-Tropsch synthesis with the improved IG Farben method of high-pressure hydrogenation is recommended for the production of engine fuels in keeping with specifications on the basis of hard coal and that the improved IG method is the most economical process for the production of engine fuels on a basis of brown coal.

The feasibility study was based on standardized plants with an annual capacity of 3 million t of engine fuels whereby NSW and Queensland were to account for 50 percent, each, carburetor fuel and diesel fuel, while Victoria was to supply 66-2/3 percent carburetor fuel and 33-1/3 diesel fuel. The assignment for NSW and Queensland concerning LPG production called for a maximum of 15 percent in terms of motor fuels while no LPG was to come out of Victoria as a product ready for sale. The hydrogenation tests for the individual coal grades were performed in the Federal Republic with members of the consortium--Imhausen-Chemie GmbH, Lurgi Kohle and Mineraloetchnik GmbH, Ruhrkohle AG [Incorporated], Rheinische Braunkohlenwerke AG, Ruhrchemie AG, Salzgitter Industriebau GmbH, and Uhde GmbH--or by specially designated institutes. The results of these hydrogenation tests constitute the foundation of this study.

#### Documentation for Technical and Economic Evaluation

All documentation necessary both for the technical and the economic evaluation of the project was developed in close cooperation with the Australian partners. These data include the following:

1. Data on location and site conditions, that is to say, on the topographic location of the planned plants, the environmental conditions, the coal deposits, the location of the future ash dump, the traffic connections, water supply, and the possibility of using waste water.

The plant in NSW was to be built in the Upper Hunter Valley, about 8 km from the city of Scone. The site for the plant planned in Queensland is near the city of Wandoan.

The Latrobe Valley was selected for the Victoria project. In all three cases, the sites were selected in the immediate vicinity of the coal deposit. In designing the processing plants, with reference to the necessary safety mechanisms and the possible effects on the environment (waste water, noise, and immissions), the corresponding requirements and standards of the FRG were used as basis.

2. The resources requirements--such as, for example, electric energy, steam, cooling water, etc.--were recorded for each individual processing plant and the required installations for a complete and energy-autarchic plant (power plant, re-cooling plants, fresh-water treatment unit, tank farm, oxygen plants, workshops, etc.) were also considered during the dissemination of the investment costs.

3. Another group of data relates to personnel planning, specifically, to the personnel requirement during the period of construction and then to the personnel requirements for operations, maintenance, and repair as well as administration. In NSW and Queensland, administration, operations, and maintenance would require 3,155, each, while in Victoria the personnel requirements would be 2,215 in case of pure hydrogenation.

4. The calculations which were made concerning the actual construction activities--preparing the timetable and determining the actual working hours

certain return figures for each object which were once again computed for additional assumptions, for example, regarding the different ways of considering inflation parameters. The model parameters among other things included the following assumptions: Inflation rate in the chemical process industry of the FRG 6 percent per year; in the Australian chemical process industry 8-12 percent per year, personnel cost inflation for Australian manpower 10-14 percent per year, inflation rate for final products 11-15 percent per year, inflation rate of coal prices 5-10 percent per year, depreciations: Linear depreciations.

As part of the sensitivity analyses, the effect of the most varied factors on the earnings and expenditure sides was investigated. The following definitely exert influence here: Product prices and their relative price movements, capacity utilization in the plant as such, construction costs, rates of exchange and costs of coal; the following are less sensitive: Personnel costs, relative equipment price fluctuations, depreciation rate, taxes and customs duties, insurance premiums, community taxes, overhead costs, general expenses, and, finally, financing arrangements.

#### Macroeconomic Factors

The profitability figures, determined for the plant planned in Victoria--with brown coal as raw material--on the basis of the discounted cash flow rate of return method, show us that this plant will operate profitably under the assumptions concerning the future of development of costs and prices.

In the analogous calculations of the return figures for the locations in NSW, with hard coal as raw material, and Queensland, again with hard coal as raw material, we also obtained good figures. If we include general economic considerations of the individual federal states and the overall interests of the Australian federated state in our considerations, then it would be meaningful to go into further detail on all of these three projects and this indeed is to be expected.

By way of supplementation, the study also points out that, in the case of capital-intensive products, such as coal liquefaction plants, an increase in product prices after the completion of the capital investment can quickly be expressed in an improvement of the earning power. That applies even if cost inflation attains the same order of magnitude as the rise in product prices. If one wishes to wait with the implementation of synthetic fuel projects until the international oil prices have reached such a level that high returns can be achieved already during the first few years, then a negative development might be triggered.

The study concludes with references to the macroeconomic factors which must also be considered in evaluating the economic feasibility calculations. This includes the following:

1. Additional employment possibilities. Beyond the personnel requirements for administration, operations, and maintenance, the influx of secondary enterprises in the area to be serviced could in each case lead to the creation of a total 6,000 new jobs.



required--start with the assumption that the construction of the plants in Australia will be begun on 1 January 1984 and that the construction time will extend over 6 years so that the plants will go into operation in January 1990. The entire personnel requirement for the construction of the plants, expressed in man-months, was estimated at 190,000, each, for NSW and Queensland and 150,000 for Victoria. The personnel requirement for the preparation of the site, for the general organization of the enterprises participating in the erection of the plant, and for transportation as well as services at the construction site is not included in the above figures.

#### Investment Expenditures

Considering all of these documents and the initial technical figures, the investment expenditures were calculated for each individual production plant, including the auxiliary plants, on the price basis as of the middle of 1980, first of all in DM figures and these were then converted into Australian dollars (A\$). These computations also contain the expenses for license and know-how contributions for standard technologies.

The following pure investment expenditures were determined: NSW 3.57 billion A\$, Queensland 3.49 billion A\$, and Victoria 2.64 billion A\$. Individual divisions of the plants among others include the following sums (given in millions A\$ in the sequence of NSW, Queensland, and Victoria): preparation and hydration of coal 892, 885, 819; synthesis gas generation and Fischer-Tropsch synthesis 693, 672, --; refinery 325, 318, 278; power plants, 639, 638, 748; secondary installations and additional facilities, 556, 545, 313. If we also figure the maritime and inland transportation costs, the development of land at the site, the capital costs, and the operating costs for the temporary camp for the personnel sent by the construction companies, plus the development costs for the ash dump, customs duties for imported systems components and project management for the construction time as such, we get total costs of 4.13 or 4.02 or 3.11 billion A\$.

On the basis of this investment cost determination and with the help of the discounted cash flow rate of return method, an economic analysis of the projects was used as basis in the light of the following assumptions: Each plant is an independent enterprise whose exclusive business activity consists in the operation of the coal liquefaction plant. A construction time of 6 years and an operating time of 20 years are being assumed here; the asset investments relate exclusively to the construction time; the operating capital is to be supplied from the company's in-house funds; tax obligations exist toward the communities, the federal states, and the Australian Commonwealth; the effects of inflation are considered in the context of the average annual rate of inflation and the investments in plant and equipment will be financed by means of long-term loans.

Wholesale prices (excluding the mineral oil tax), based on the data from the Australian Prices Justification Tribunal as of 1 June 1980 were used for the product prices. In place of the unavailable data on typical marketing and sales costs in Australia, a certain assumption was made per liter of product. A comparison of the average flow and the expenditure calculation gives us

2. The construction and operation of coal liquefaction plants promotes a higher educational level among the personnel--an effect which can generally be favorable for the country.

3. The Australian economy's autonomous supply capability is improved along with effects on all sectors of the national economy and dependence on crude oil supplies from abroad will decline.

4. An improvement in the balance of trade is closely connected with this because crude oil--especially in case of rising world market prices--can be replaced by products deriving from domestic coal supplies.

5. The Australian economy will grow in terms of highly-developed technologies which can fertilize not only future technical developments in Australia but which would also lead to a situation where an economy, heavily geared toward the export of valuable raw materials, is replaced by a refining economy based on domestic deposits.

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## ENERGY

### MODERN COAL TECHNOLOGY: FLUIDIZED BED COMBUSTION

Duesseldorf HANDELSBLATT in German 2 Jun 82 p 27

[Article by Karlheinz Ludwig: "Modern Coal Technology--Ash-Rich Coal Also Burned Up in Fluidized Bed"]

[Text] Tighter environmental protection regulations compel far-reaching noxious substance elimination during coal combustion. One effective method here is the burning of coal and low-grade fuel in the circulating fluidized bed. Fluidized bed technology has been used successfully for almost 30 years in chemical industry processes. It is now used to generate process heat and electric energy. Ash-rich and sulfur-rich waste coal washing piles, as well as residues from coal refining processes can be burned in this way just as much as high-grade coal but also oil shale and sulfur-rich oil residues.

ZAWSF ("Circulating Atmospheric Fluidized Bed Furnace") is also suitable for environmentally safe power and thermal power plants with hard coal furnaces. Particularly interesting is the ZAWSF for plants which, for reasons of economy, require a thermodynamic design with high steam parameters--but also with intermediate superheating--and which create high requirements both in terms of the regulation capability and also in terms of the speed of load [charge] change. Here, ZAWSF is distinguished by the following:

Desulfuration in the furnace at very low limestone consumption;

Little nitric oxide formation as a consequence of lower combustion temperature and two-day combustion management;

Plus high carbon burnup due to the longer time the fuels spend in there;

Possibility of using a broad range of fuels, including ballast-rich, low-volatile, and sulfur-rich coal;

Good adjustability of plant also in the partial-load and low-load range with adequate load gradients;

High overall efficiency compared to conventional boilers with flue gas desulfuration system;

Small structural volume, therefore lower investment and operating costs compared to conventional systems with flue gas desulfuration;

Suitability for the construction of larger units of up to, initially, 150 MW<sub>el</sub> and, in the future, up to 300 MW<sub>el</sub> in one module.

An example of ZAWSF is a system for environmentally safe coal combustion which is just about to be placed in operation at VAW (United Aluminum Works) at the Luenen plant. The plant generates 83 MW<sub>th</sub> by means of the combustion of cheap, high-ballast-containing coal. A portion of that heat is used via a salt heat exchanger to heat a high-temperature salt melt as heat source in a process stage of aluminum oxide manufacture. In the past, this salt melt was heated in special oil-fired or gas-fired combustion chambers. The steam likewise needed in the plant--previously generated by burning high-grade nut coal--is then produced at 64 bar and 480°C likewise in the ZAWSF system. The greater economy of this new technology ought to be quite obvious even now.

In using this technology however we go even further today: Plans call for supplying an entire industrial enterprise with all currently available energy types on the basis of a single raw material, that is, coal. Here again, the Luenen plant of the VAW has been mentioned as an example. Clean fuel, such as oil or gas, must be used for the aluminum hydroxide calcination step (likewise in a circulation fluidized bed) which consumes much heat. It is therefore impossible directly to charge coal here.

In order nevertheless to be able to work with coal, the heat is generated with the help of a coal gasification system that works according to the principle of the circulating fluidized bed. Here the coal is only partly gasified by adding hydrogen and oxygen at atmospheric pressure--just as far as necessary in order to cover the share of the combustion gas in the context of the plant's overall energy balance. The still heavily carbon-containing residues are then burned up in the ZAWSF system with a total output of 83 MW<sub>th</sub> and are converted into process heat or current and steam.

Modern methods make it possible today to produce steel even without blast furnaces. But we work with a reasonable cost structure here due to the direct reduction of iron ore with natural gas or coal into sponge iron. In contrast to the increasingly poor scrap qualities, sponge iron is free of harmful alien metals and is directly melted into steel, with even highly-pure qualities in electric steel plants. Low investment costs, better market adjustment, lower personnel requirements, and environmentally safe operation enhance the significance of direct reduction.

Direct reduction, using natural gas in a continually operating shaft furnace, can be economical only for countries with their own natural gas deposits in view of the high energy prices. Direct reduction on the basis of coal permits the use of low-grade, noncokable coal. As reactors we use here rotary

furnaces, such as they have proved themselves for a long time also in the lime and cement industries. They are insensitive to the size of the raw material grain. This is why cheaper ores and concentrates can also be charged indirectly.

Coal and ore are charged into the revolving pipe simultaneously. During the movement through the reactor, the coal is used up at temperatures of around  $1,000^{\circ}\text{C}$ . The carbon monoxide generated in the process reduces the ore, still in the solid state, to a metallic product, in other words, sponge iron. By blowing air in to burn up the surplus carbon monoxide, we get a controlled temperature. The combustible volatile coal constituents are used to heat up the raw materials in the forward portion of the revolving tubular furnace; the hot waste gases can be used for steam generation. Sponge iron and residual coal are cooled after leaving the rotary furnace and are separated from each other magnetically.

More than ten plants are already using this method, mostly in countries without their own coking coal deposits. In New Zealand, for example, where inferior brown coal and local iron sand concentrates are used as raw material base, steel production independent of imports was made possible only by this method developed by Lurgi.

Low-temperature coal carbonization and coking are among the oldest methods for refining coal. The coal is degasified; by heating the coal, we can expel its volatile constituents. They consist of gas and tar as working materials. The coke is then left in terms of quantity and as the most important product. As a smokeless fuel it used to be quite in demand in households and small enterprises. It is the most important means of reduction for the iron industry.

The coking of caking hard coal in chamber furnaces is a traditional technology. By means of carbonization involving gas recirculation [purging of distilled gas by rising gas] however we can also process noncaking hard coal and brown coal. The latter of course must be predried and, when we are dealing with place brick coal, it must also be briquetted. In the shaft furnace, the coal is finally dried first of all in the upper part. Low-temperature carbonization takes place in the main part at  $800^{\circ}\text{C}$ . The cooling finally takes place in the lower part. This circulating cleansing gas is used for degasification and is partly burned up in case of a shortage of air. In this way, the heat requirement for low-temperature carbonization can be supplied in a simple manner. The low-temperature carbonization gas contains tar, oil, benzene, and water vapor. They are separated during gas cooling by means of condensation. The main products are either coke or tar, dependent upon the market situation.

The Lurgi-Ruhrgas method is used to generate low-temperature carbonization gas and city gas through the degasification of high-grained hard coal or brown coal along with the procurement of fine-grained coke for metallurgical purposes or for steam boiler furnaces. This method is significant also for the future processing of oil shale and tar sand deposits which are found worldwide. The main characteristic of this method is the use of fine-grained heat sources

which are managed in a cycle. Additional characteristics are the simultaneous heating and the pneumatic conveyance of the heat sources so that there is no need for a separate apparatus for heating. After heating, the heat sources are brought into direct contact with the charge material; as heat sources we use sand, coke, and similar products, preferably the reaction residues formed in the course of the process itself.

On a large industrial scale, coal has been gasified for decades to make heating gas, reduction gas, or synthesis gas (for the production of fuels, chemical raw materials, or district gas). Here the coal is converted as completely as possible into gas mixtures ( $\text{CO}$ ,  $\text{CO}_2$ ,  $\text{H}_2$ ,  $\text{CH}_4$ , etc.). As gasification agent, we use, for example, mixtures of air or oxygen with water vapor or hydrogen. For industrial use, we have three autothermal methods available:

Gasification in the fluidized bed (Winkler method),

Gasification in the flue dust cloud (Koppers-Totzek method),

Gasification in the solid bed (Lurgi method).

The Lurgi process so far is the only method used on a large scale under pressure (20-30 bar). More than 90 percent of the coal gasification capacity available today and planned for the immediate future are based on that. In the Lurgi pressurized gasification method, we use the countercurrent principle. The coal is moved from the top down through the gasifier, whereby it goes through various zones (drying, low-temperature carbonization, gasification, combustion of residual coke). The gasification medium, for example, a mixture of steam and oxygen, and the raw gas flow from the bottom to the top. The coal is moved through a coal lock into the reaction chamber which is pressurized. We use a revolving grate to remove the ash and then the ash is taken out via an ash lock.

Using this reactor principle, we can produce various types of gases, for example, lean gas (industrial heating gas, combustion gas for combined gas-steam turbine power plants), heating gas with city gas quality, synthesis gas for the production of methanol, ammonia, liquid fuels and SNG (district gas). The potential of the reactor principle was definitely broadened in recent years as a result of intensive development efforts.

Pressures of up to 95 bar were attained in the "Ruhr 100" high-pressure gasifier; under these conditions, the methanol content of the gas (and thus also the caloric value) were definitely increased; it was also possible definitely to reduce the specific consumption of coal, oxygen, etc., as well as the yield of liquid hydrocarbons. This leads to a simplification of the subsequently connected system parts.

The so-called British gas-Lurgi slag tapping generator was developed in cooperation with British Gas; here the slag is obtained in liquid form. This is achieved in that--by means of a low steam-oxygen ratio in the gasification agent, amounting to about 1:1--we can adjust temperatures which are above the ash melting point. In contrast to that, the revolving grate generator requires a steam-oxygen ratio of at least 5:1. Here we get the ash in a granular form.

In the variations of solid-bed gasification, we can use practically all types of coal and we can produce gas for various purposes. This has been proved by the more than 160 gasifier units built so far.

Coal is the basis for chemical raw materials which also include tars, oils, gas-benzene, and phenols. Here, coal pressure gasification offers two possibilities for the production of high-grade fuels. One of them leads via the conversion of synthesis gas with low-pressure methanol synthesis to methanol. Here, the coal can be converted into methanol with a thermal efficiency of 50 percent. The efficiency goes up to 62 percent if the system is so designed that we will also get SNG (synthetic natural gas, in other words,  $\text{CH}_4$ ) which we for example can feed into the natural gas network. Methanol is used as a chemical raw material and fuel additive or to operate motors especially designed for methanol operation. We can go one step further and, using the Mobil method, we can produce gasoline from methanol via a catalyst. A reactor system which can be used on a large scale in industry has already been designed for this purpose.

In the second variant we are dealing with the large-scale industrial production of gasoline and diesel fuel from synthesis gas with subsequently connected Fischer-Tropsch synthesis. This technique was used in Germany during the middle of the 1950's until (here likewise) it became uneconomical as a consequence of cheap crude oil. Only the Republic of South Africa continued to show interest in this. That country had large deposits of ash-rich and cheap hard coal available as raw material. The Fischer-Tropsch synthesis method was just about ideal here. Sasol I has been in operation since 1955; Sasol II is a plant which has been in operation since 1981 and is ten times bigger; Sasol III is to be placed in operation by the end of 1982. The idea then is to process 33 million t of hard coal in all three plants annually; that is tantamount to 40 percent of Germany's hard coal output. South Africa then produces 4.5 million t of liquid fuels per year. According to government data, Sasol is supposed to cover more than half of South Africa's fuel needs.

The Fischer-Tropsch synthesis method is a fully developed process for coal liquefaction. After pressure gasification of the coal, the raw synthesis gas is purified in the "Rectisol" method. The synthesis gas--which consists primarily of carbon oxide and hydrogen as well as smaller parts of methane and residual carbonic acid--is converted into hydrocarbons in the Fischer-Tropsch reactor system with an iron catalyst. German companies developed a special cube reactor for this (Lurgi-Ruhrchemie high-performance reactor). The main products from this process are gasoline, diesel fuel, district gas, liquid gas, and ammonia.

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## INDUSTRIAL TECHNOLOGY

### FIRST INTELLIGENT ROBOT OPERATIONAL IN RENAULT PLANT

Paris L'USINE NOUVELLE in French 1 Apr 82 p 56

[Article by Michel Defaux]

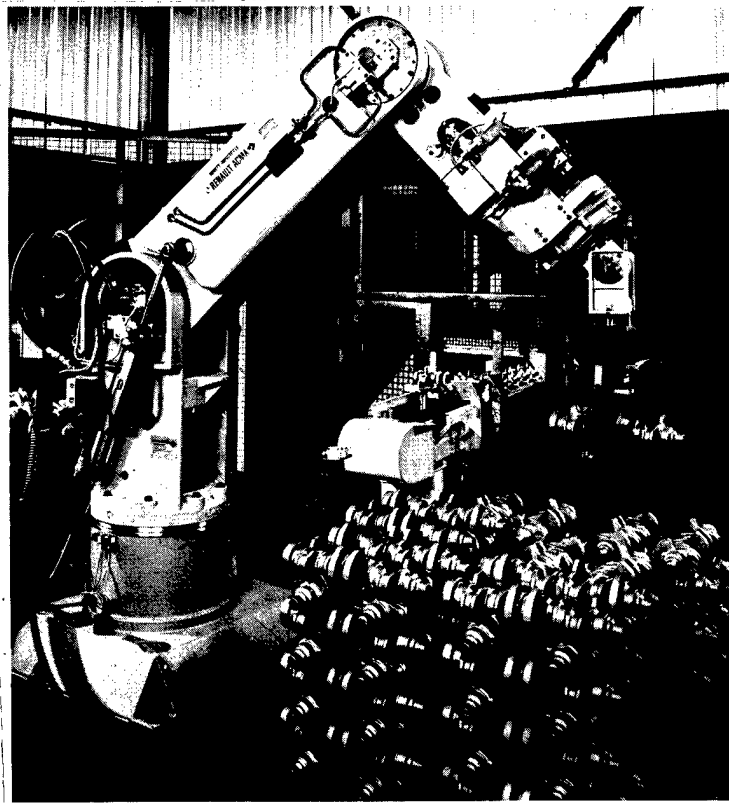
[Text] The first French shape-recognizing robot is in operation. Located at the Renault Cleon plant, it has made it possible to perfect various components of the system, and opens the way for other applications of artificial intelligence.

The shape-recognizing robot developed by Renault's Division of Advanced Technologies and Automation (DTAA) is now in operation. Installed in August 1981 at Cleon, it was only 50 percent efficient last February; today, its efficiency has grown to nearly 95 percent. This vertical robot grasps crankshafts cross-piled on pallets (108 crankshafts in six layers) and feeds a machining line. Located in front of the loading station of the line, it alternately services two pallets located on its left and right (pallet positioning is plus or minus 5 cm). Two fixed cameras are located above, and sixteen mercury lamps illuminate the parts, since ambient light and especially direct sunlight on the crankshafts had raised many problems at the beginning.

This installation in an industrial environment has made it possible to select and perfect the system's various components (sensors, grip, cameras). For instance, the sonar installed in the grip is the same one mass-produced for Polaroid cameras; it is a simple, inexpensive, and reliable sensor, with a linear response which makes it possible to extract information of the order of a millimeter.

An information phase (90 s) begins with the arrival of a full pallet: the robot measures the six piles with its sonar (scale correction of the camera) to determine which cycle to enter (it always begins with the uppermost because it is easier to grab). It then calculates the center of gravity of each pile from an image, and corrects the initial grasping program. One point on the crank of each shaft is verified to determine the alternation of positions. The actual grasping cycle can then begin: the camera then concerns itself with only one single pile. The information gathered is filtered and memorized; it is then used to calculate the X and Y coordinates, the position of the center of gravity, and the angle of the crankshaft (a deviation of 15 degrees from the axis is tolerated). The grip-to-part





Shape recognizing robot for unloading crankshafts from pallets and loading them on a machining transfer line.

distance is measured by the sonar device. The grip is self-compensated in the finger closing mechanism, and can thus accept an error of 10 mm in position location. The robot grasps the crankshaft, places it in the proper position (large diameter always on the same side), and loads it into a vee on the line (positioning precision of 4 mm).

The recognition cycle (23 s) is repeated for each part, but occurs during idle time (while the robot works). "We developed sufficiently fast algorithms," states Jean Bach, computer engineer at DTAA, "but we had to use many tricks to reach a processing time of 2.5 s."

This achievement is a compulsory milestone for all future applications: assembly, arc welding, deburring, part inspection, grasping from random piles. There is no shortage of projects, and some of the tools are already available.

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## INDUSTRIAL TECHNOLOGY

### TMI-FOREST USES CAD IN MACHINE TOOL MANUFACTURE

Paris INDUSTRIES & TECHNIQUES in French 10 Mar 82 p 31

[Article by A. P.]

[Text] Half as much design work, and real-time cost control.

Of all the European machine-tool builders, TMI-Forest was the first to adopt computer-aided design (CAD) in September 1980. Since then, computerization has not stopped in the Capdenac plant: terminals have appeared everywhere to measure real-time manufacturing and design.

CAD began with hydraulic components, whose drawings are stored in the computer. These were followed by electrical components, which are ten times more numerous, and whose drawings were difficult to subcontract. "With the computerization of electrical and hydraulic parts, we have halved the load of design offices," declares Pierre Tillemand, head of this sector. "The first consequences have been a displacement of personnel, a reduction in subcontracted studies, and better prototype quality." Today, it is the turn of mechanical components, but the dimensions of the manufactured parts make the application more difficult. The profitability of CAD is highest for a family of applications of the same type: in that case, the parameter categorization of a part model results in an enormous gain. Let us assume a strut: the designer brings the basic drawing on the screen, where the operator answers questions about the values of each desired characteristic. The drawing is changed accordingly, and the computer calculates the optimum values for any given characteristic. If the part model requested by the operator does not exist in memory, it is still possible to draw it directly on the screen by means of joined straight and curved lines.

Several mechanical parts are already being drawn on this system (the CV CADSS3), beginning with 20 families of struts, simple shapes of revolution suitable for training the designers, and a ball screw, a vital part which defines the machine's design time. CAD should cut the time for this part by two to three weeks.

At TMI-Forest, despite the large variety of products (machines for aeronautics, milling machines, planers, borers, and machining centers with capacities higher than 800 mm to the cube), CAD provides great flexibility, eliminates huge files, and

helps solve complex-shape problems. The machine presents drawings in a pleasant and uniform format, translates them into English or German, and adapts them to ISO standards. A plotter makes the drawings during the night, without supervision.

The system reopens the question of the traditional standards and methods. For instance, draftsmen-designers had been working by copy and identification; henceforth they will reason by function.

One feature is retro-indexing: the end of a file indicates the locations of any given component. This avoids searching and listing each type of component.

With two raster screens, the designers do not need to erase what is already on the screen in order to obtain additional information: they merely have to show this information in the background. There is however a problem: the screen definition (500 x 500 lines) is inadequate for operator comfort, and for viewing large-dimension mechanical parts. TMI-Forest expects to move to 1000 x 1000 lines.

Another one of CAD's uses is computation, as when representing in three dimensions the collision risks between a part being milled, such as an alternator rotor for instance, and the platform of the machine's carriage. This type of situation is difficult to draw by hand. To this, Pierre Tillemand adds the calculation of the oil volume needed in a carriage with five axes of rotation.

The idea for using CAD was born during a visit to Sicob in 1979; eight months later it was a reality. Engineers had first been trained in industrial data processing, and they were assigned immediate applications tasks. Today, eight terminals are used for logic and machine power designs.

In the future, the system will be converted to CAD/CAM (computer aided manufacturing). Upon receipt of a file, the designer will send the part-machining program to one of the numerical control machines in the shop. For the time being, TMI-Forest writes its programs with Promo-assisted programming.

But CAD is only one of the elements of the enterprise's computer orientation, which is centered around an IBM 34 with 128K-memory. In parallel with its design work, the designer's terminal automatically transmits a parts inventory to the central computer, which draws from it information indispensable for supply. In addition, a Solar 16/40 computer with a 320K-memory gathers together the information collected by the time-keeping terminals in shops and offices. This extends beyond a computerized personnel management. Each worker or designer enters his badge in the appropriate terminal when he changes jobs or machines; as a result, the exact time needed to complete each part is readily determined. The time distribution of design shops is divided among the total parts of each run. The Solar 16/40, connected to the administrative services through the IBM 34, results in a double advantage: TMI-Forest adjust in real-time the cost of parts estimated by the sales department before the introduction of the machine. When the machine is finished, its exact cost is well known, thus ending the guessing game once and for all.

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CSO: 3102/237

## INDUSTRIAL TECHNOLOGY

### MANUFACTURING CELL DEMONSTRATED AT BRITISH EXHIBITION

Duesseldorf VDI NACHRICHTEN in German 9 Apr 82 p 4

[Article: "Multipurpose Robot Attends Standard Machine Tools"]

[Text] A manufacturing cell unattended by human operators was exhibited at the British fair "Metcut" in late March and early April in Birmingham. Among other things, it consists of a CNC lathe, a conventional production milling machine, an industrial robot with computer control and costs about DM 700,000 including the interface for the milling machine and the robot's grippers.

The combination presently being exhibited in Birmingham clearly shows that automatic manufacturing cells do not have to be built exclusively around machine tools with CNC or other programable controls.

The small-computer based robot control "Acramatic" is the brain of the manufacturing cell. The CNC system is logically coupled with condition signals related, for example, to the machining process and can also control precision tool feed and thus can fully automate a processing system provided that the machine incorporates certain features that are common for CNC lathes and processing centers.

The T<sup>3</sup> industrial robot is positioned almost exactly in the center between the two machine tools which are arrayed back to back. This arrangement differs from the common practice for such manufacturing cells wherein the robot is stationed in front of the machines. It offers advantages such as space savings and safe, unobstructed access to the front of the machines for tool rigging and adjustment, inspection, maintenance and when required monitoring by a human attendant.

Insertion and removal of the workpieces from the back of the machines is possible only because of the T<sup>3</sup> robot's considerable reach and its agile hinged arm construction with six degrees of freedom. Two separate turning operations and one milling operation are performed on preprocessed blanks with a diameter of 100 mm and a length of 150 mm.

The hydraulically operated double gripper with two individually activated steel gripper pairs, which can grasp and transport the workpiece in various attitudes, provides for rapid change of work piece. After the first turning operation is finished, for example, the robot accomplishes a change of workpiece in three steps as follows:

--Gripper 1 grasps the machined part after which the chuck is loosened and the center stock is retracted. The new workpiece is held ready for insertion by gripper 2.

--The gripper mechanism describes an arc, stopping about halfway. During this pause a powerful jet of compressed air is blown over the chuck jaw to remove chips as the lathe spindle simultaneously makes a full turn.

--The arm resumes its arc motion and gripper 2 goes to the center of the spindle and inserts the new workpiece into the chuck. Finally, the gripper mechanism retracts completely from the work area of the machine.

The entire process of changing a workpiece from the initial grasping of a new blank to the release of the newly chucked part consumes not more than 15 seconds. Changing the workpiece on the milling machine involves the same sequence of steps: removal of the finished part; removal of chips from the chuck with compressed air and insertion of the new workpiece between the chuck and tail stock.

For the first lathe operation the unmachined blank is secured in a power operated chuck and the other end is center-supported on the tail stock which is likewise power operated. For the second turning operation, the automatically retracting tail stock is swung downward so that internal cutting tools can be brought into position. In the third and final step, six keyways are milled into the lathed part.

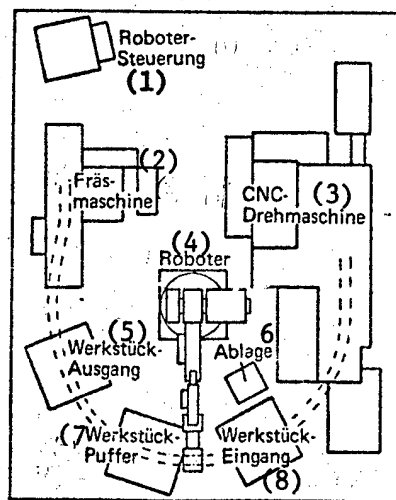
The T<sup>3</sup> robot in combination with several pallets which are arranged within its reach provides a system for transporting the workpiece through this manufacturing sequence. The input pallet consists of a simple metal frame encasing a thick wooden plate containing 30 drilled holes for holding the unmachined parts. The three-dimensional location of each of these 30 holes is stored in the robot's computer memory by a teaching process. With this stored information, the robot can locate, grasp and insert the blanks in the lathe in a prescribed order.

A similar output pallet also containing 30 holes serves as a receiver for the finished parts after the final milling operation. The finished parts are also deposited in a prescribed, memory-stored order in the output pallet since this is the most economical solution. However, it is also possible to locate the pallet positions in a free, or unspecified, order using modern sensor equipment, but this entails added costs.

Two other workpiece handling stations are provided. The workpiece handling table has two separate pairs of prismatic supports on which the grippers can temporarily place the partially machined parts coming out of the lathe in preparation for the next machining operation. When initially lifting the workpiece out of the input pallet, the gripper grasps the blank very close

At the end of the first turning operation, the part is machined so close to the chuck that the gripper can not grasp it on the original diameter. However, the gripper's adjustment range permits it to grasp the partially machined part on the 55-mm-diameter section in order to remove it from the lathe and to lay it on the prismatic supports. At the point in time when this part will again be placed in the lathe for the second turning operation, the gripper grasps the short piece of the still unworked original diameter in order to shove the other end of the workpiece into the chuck. A buffer storage receives finished lathed parts if these yield while the milling machine, whose work cycle is not synchronized with the lathe, is still busy with another part. In practice this buffer storage can be used as an inspection bench for checking critical part dimensions, and when required a signal will be sent to the CNC control which will initiate an automatic adjustment to the lathe tools.

At the center of the manufacturing cell stands a T<sup>3</sup> industrial robot with six degrees of freedom and computer control. The workpiece input and output pallets have 30 workpiece receptacles in each case. The workpiece handling station permits the robot to make gripper manipulations between machine operations. The workpiece buffer storage serves to coordinate the unsynchronized duty cycles of the lathe and milling machine. The cell can still be expanded, for example by additional processing stations; inspection stations with or without automatic tool monitoring and/or compensation; automatic workpiece input and output conveyors instead of fixed input and output pallets, etc.



1. Robot control system
2. Milling machine
3. CNC lathe
4. Robot
5. Workpiece output station
6. Workpiece handling station
7. Workpiece buffer station
8. Workpiece input station

## TRANSPORTATION

### INTERVIEW WITH HEAD OF AIRBUS INDUSTRIE

Rome AVIAZIONE in Italian Mar 82 pp 150-153

[Interview with Bernard Lathiere, president and "chief executive" of Airbus Industrie by Paul Denarie: "From Toulouse: We Have Beaten all Aircraft Builders including the Americans"]

[Excerpts] We have been able to get 50 percent of the worldwide market for "big carriers." With the A320 we are planning to win 25-30 percent of the market. We are open to almost any offer of collaboration, even with the devil.

Toulouse--With the air transport crisis getting worse and with the oil crisis which is becoming a permanent fixture, there are not many particularly "happy" transport aircraft manufacturing industry leaders. In 1981, Boeing sold only 23 747-aircraft and four 767-aircraft; McDonnell Douglas had to be satisfied with eight DC-10 and Lockheed was able to sell only five Tristar aircraft. The latter then had to resign itself to announcing the end of the career of this three-engine aircraft<sup>1</sup> which inflicted heavy losses on the company and no more than 21 aircraft are to be delivered between now and the end of 1984.

On the other hand, Bernard Lathiere, the general manager of Airbus Industrie, 53 this spring, keeps smiling. This is because he has some good products and because the Airbus family is selling rather well. "The year 1981," he says, "was a good year. With 46 firm orders and 30 options, we sold almost the same number of aircraft as the year before (50+36) during a period when the crisis had not yet reached its current magnitude. In 1981 we thus got 50 percent of the worldwide market for big carriers as against 24 percent in 1980 and we got 82 percent of the market for medium-range, wide-body aircraft. We beat the three combined American aircraft manufacturers."

Lathiere continues: "This gives us a total of 505 Airbus sold, including, 346 firm (258 A300 and 88 A310) plus 159 on options (69 A300 and 90 A310). The total number of orders comes to 158 aircraft for 26 companies of which 39 were delivered to 19 operators last year. This means that we still have 347 aircraft to deliver. Even though the time of the 'big race' is over, it is reasonable to think that we will arrive at a figure of 1,000 aircraft."

[Question] This is a nice figure but do you not think that the figures will be less wonderful in 1982?

[Answer] No, we think that we will maintain the same sales pace. The 500th Airbus should come off the assembly line in the spring of 1986 and we will continue to increase the output rate. The latter rose from 3.6 aircraft per month at the end of 1980 to 4.2 aircraft at the end of 1981 and, as planned, we will get up to 8 aircraft per month by the end of 1984. During the signing of the contracts for the 747 and for the Airbus with Singapore Airlines, on 15 December, Boeing Chairman Thornton A. Wilson asked me: "We have already laid off 6,000 persons and we are about to lay off another 12,000. How many people are you about to lay off?" I replied: I am hiring. Right now there are 20,000 persons in Europe who are working for Airbus Industrie; within 3 years we are going to have 45,000 at the peak of the production rate with the arrival of the small Airbus A320 which has 150 seats.

[Question] What are the big events anticipated by Airbus Industrie in 1982?

[Answer] First of all, on 18 January we delivered the first large-capacity aircraft to Garuda with only two pilots. Then, in the spring, by the end of March, we will have the first flight of A310. Finally, in the summer, we will effectively launch the A320.

[Question] Could you briefly review those programs for us?

[Answer] You mean the A300? The first versions, B2/B4, are becoming more difficult to sell with the appearance of the B4-600 during the second quarter of 1983 which will be available a year later. Considering the fact that, in times of crisis, smaller aircraft sell better, the A310 is at this time the easiest to sell. However, we will deliver about 50 B2/B4 this year and quite a few more after that date.

[Question] According to some people, sales of the A310 are taking off slowly. What do you think about that?

[Answer] Nothing, as a matter of fact. We sold 178 A310 aircraft even before the aircraft made its first flight, whereas we had only sold 31 aircraft prior to the maiden flight of the A300 on 28 October 1972.

[Question] Can French arms sales to Nicaragua slow down sales in certain countries as in the case of Abu Daud [Abu Davi] which, it is said, cancelled the order of Western Airlines?

[Answer] No, but our competitors can exploit that situation and can put the skull and crossbones on the French flag. That would not exactly be fair play but all is fair in war.

[Question] Boeing staged a big ceremony for the rollout of the 757 at Seattle. Are you going to do the same for the A310?

[Answer] We have decided not to do anything of that kind. A rollout costs half the price of a show such as Farnborough. The A310 is a member of the Airbus family. It is No 162 in that line. It therefore is not an entirely new aircraft. Our idea is to make personalized presentations on the order of the delivery of the aircraft to each client. The aircraft, which is the first



of Swissair, will be painted on one side with the colors of the Swiss company and on the other side with those of Lufthansa which will get the third A310 (No 191 in the line) in the spring of 1984.

[Question] Certain carriers are asking you to space the shipments out. What is the situation between you and Laker at this time?

[Answer] Laker is having problems with its banks. It is not its three Airbus aircraft which lost money; they lost money with the DC-10 on the trans-Atlantic lines. This situation should be cleared up in one way or the other within a few weeks. In the past, certain postponements, especially in Europe, enabled us to sign contracts with neighboring lines, particularly with VASP (three A300B2, ordered on 30 October 1980, to be delivered by the end of 1982).

[Question] Did the fact that socialists came to power in France on 10 May of last year change anything as far as Airbus Industrie is concerned?

[Answer] Nothing has changed as far as our European partners are concerned. But I did have to explain to the United States that the Airbus could always fly also if a communist minister was in charge of transportation (in France--editor's note).

[Question] Let us now take up the A320. It does not look as if it would be moving too fast.

[Answer] Important representatives of Delta Airlines are now in Toulouse with the company's number two man. They need almost 120 aircraft; that would give us 200 aircraft with Air France which signed an order for 25+25 A320 on 6 June of last year. Their visit to France does not mean that they are going to buy but it does demonstrate their interest. If they should decide, another big American company (Continental? Eastern?) could decide to fly those planes. But I want to make it clear that the launching of the A320 does not depend on any possible order from Delta. If they do not order anything, that could not slow down the launching of the program.

[Question] In your opinion, is the time for decision far off?

[Answer] Yes, I would have preferred to have Delta decide at the beginning of last autumn but 6 years would have been necessary to launch the A310! Delta can become one of the launching companies together with Air France but six other carriers in Europe, in Africa, in Asia, and in America are already interested in the program. Yes, they do include British Caldeonian.

[Question] What is the market for the A320?

[Answer] The market for this category of aircraft ranges from 3,000 to 3,100 aircraft. One part will be taken up by the 737-300 (20+40 ordered so far) and the DC-9-80 (114+21). But the real competition of the A320 will undoubtedly be the 150-seat Seven-Dash-Seven which Boeing could propose next for 1987. With the A320 we are thinking of winning 25-30 percent of the market, in other words, a minimum of 700 aircraft.

[Question] And what do you think of the MDF-100 project of McDonnell Douglas-Fokker?

[Answer] On that market I do not see a third competitor capable of spending \$2 billion for such an aircraft [as published].

[Question] Is the cost of launching the A320 therefore on this order of magnitude?

[Answer] Yes, between \$1.5 and \$2 billion, with a unit price of \$20-25 million per aircraft, in other words, half of the price of an A300/A310.

[Question] But for the time being, the A320 does not have an engine. Can you launch an aircraft without the engine while the development of a power plant takes longer than that of an aircraft?

[Answer] As a matter of fact, apart from the Rolls-Royce-IHI, there are no entirely new engines; these are improved versions. Pratt & Whitney, together with FIAT Aviazione and MTU [Motor and Turbine Union], offer us the PW2025; the British and the Japanese offer us the RJ.500-35; SNECMA [National Corporation for Aircraft Engine Design and Construction] and General Electric, through CFM International, are offering us a derivative, 2.K.1, of the CFM56, which will be available by 1986. Only SNECMA--because General Electric does not wish to share in this risk--is offering us an M56-2000 with a thrust of 11,500 kg which will not arrive before 1990; for it, we would have to find Fr600 million. The offer from SNECMA is not the way to go because we are asking for engines that would be much more powerful than the ones available now and that is not true of the CFM56-2.K.1 which is a French engine on a European aircraft; even if it were to arrive in time, it would be difficult to sell it abroad. Today, an engine can be made only through joint international production. There is a certain danger in seeing the engine-makers dragging their feet at a time when there is not a single builder ready to launch a program in this category, above all at a time when we need engines with definitely higher performance than those we have now. But if Delta, for example, were to decide in favor of the A320, the very next day, we would immediately have three engine-makers drop in on us.

[Question] How will the work on the A320 be distributed?

[Answer] In the context of the current partners, the problem is not simple. France could build the fuselage and the cockpit; Great Britain could make the wings. But the British tell us: "We do not want to keep on making just the wings and lose out on assembly and on the cockpit. We also want the cockpit." The Germans are less hesitant; they are asking us to do practically the same thing (which they are doing for the A300 and the 310--editor's note). We are discussing with the Italians and with the Spanish CASA [Harvester Suppliers, Incorporated] and last May we signed an agreement with the Yugoslav Soko Company for about one-percent cooperation. Lately we drew up a memorandum of understanding with three Australian builders who are planning to participate with 2 or 3 percent. The Belgians would like to go up from 2 percent to 4 percent and De Havilland of Canada has asked the Canadian government to be able to cooperate in the operation with a share of 10 percent from the development stage on ("full partnership").

[Question] What about the Japanese? And what about Fokker if the MDF-100 program does not get off the ground?<sup>2</sup>

[Answer] As far as the Japanese are concerned, the problem is very simple. We do not want to work with people on a completely new aircraft in order then a short time later to find ourselves facing a new competitor, as happened in the case of the shipyards. We already told them that but they want you to talk clearly, they want you to talk the kind of language they understand. Fooker? We are open to any offer of collaboration, even with the devil.

[Question] It seems that there has not been any talk for quite some time about the TA9/TAll projects.

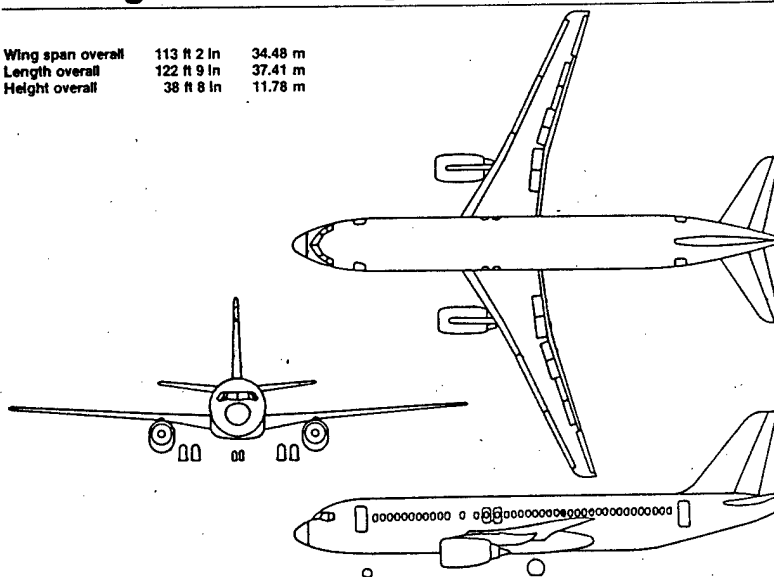
[Answer] We are doing a little less work now because we gave priority to the A320. The TA9 is bigger and more difficult to sell at this time. As for the long-range, four-jet TAll, that would be set back by the launching of a very long-range version with the action radius of the A310, in other words, 6,000 km instead of 4,800 which was asked for. This aircraft could be a good substitute for the DC-10 and the L-1011 which are not flying at full load on all of the trans-Atlantic lines. United States regulations force a twin-engine aircraft to fly at least 60 minutes from an airport whereas those of the OACI call for at least 90 minutes. We are no longer in the times of Mermoz when you had to have at least four engines before going out over the sea. And since Boeing is thinking of a long-range 767, will we perhaps see an amendment of this regulation?

#### FOOTNOTES

1. See AVIAZIONE, No 161.
2. The interview took place before the announcement of the termination of the agreement for the MDF-100.

## A320 general arrangement

Wing span overall 113 ft 2 in 34.48 m  
 Length overall 122 ft 9 in 37.41 m  
 Height overall 38 ft 8 in 11.78 m



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## A320 design data

	A320-100		
Max. take-off weight	66 000 kg	145 500 lb	71 900 kg
Max. landing weight	61 463 kg	135 500 lb	62 863 kg
Max. zero-fuel weight	57 607 kg	127 000 lb	59 077 kg
Operating weight empty	39 248 kg	86 525 lb	39 656 kg
Max. weight limited payload	18 359 kg	40 475 lb	19 421 kg
Seating, all economy 32" pitch	162		162
Passenger and baggage payload	14 697 kg	32 400 lb	14 697 kg
Cargo payload	3 662 kg	8 075 lb	4 724 kg
Hold capacity - forward	15.09 m <sup>3</sup>		
- aft	25.66 m <sup>3</sup>		
- total	40.75 m <sup>3</sup>		
Maximum fuel capacity	12 900 kg	28 440 lb	18 800 kg

Airbus Industrie Sales as of 15 January 1982

A 300 + A 310 : 505 to 43 companies  
 or : 346 firm orders  
 + 159 options

including:

A 300 : 258 firm orders  
 + 69 options

A310 : 88 firm orders  
 + 90 options

Delivers : 158 to 26 companies

A 320 : 25 firm orders  
 + 25 options

Orders Received in 1981

	<u>1</u> <u>fermes</u>	<u>options</u>
6. II.81 Thai International:	2 B4-600	+ 2 B4-600
23. II.81 T.A.A.	:+ 1 B4-100°	
18.III.81 Garuda	:+ 3 B4-200°	
25.III.81 Wardair	: 6 A 310	+ 6 A 310
13. IV.81 China A.L.	:+ 1 B4-200°	
17. IV.81 Nigeria A.W.	: 4 A 310	+ 4 A 310
11. VI.81 South African	:+ 1 B4-200°	
1. IX.81 Indian Airlines	:+ 2 B4-200°	+ 2 B4-200
15. IX.81 Libyan Arab A.L.	: 6 A 300	
	4 A 310	
25. IX.81 Egyptair	:+ 2 B4-200	
.. IX.81 Unannounced	:+ 2 A 300°	
30. X.81 Middle East	: 5 A 310	+ 14 A 310
15.XII.81 Singapore A.L.	:+ 6 B4-200	+ 2 A 310
31.XII.81 Egyptair	:+ 1 B4-200	

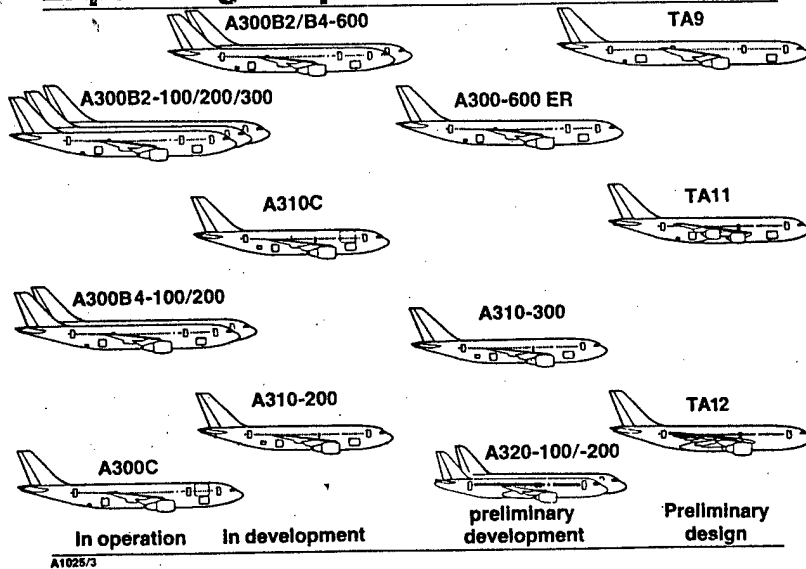
total:..... 46 <sup>1</sup>fermes + 30 options  
 ( ° = options converties)

M.O.U.( memorandum of understanding ) : 2

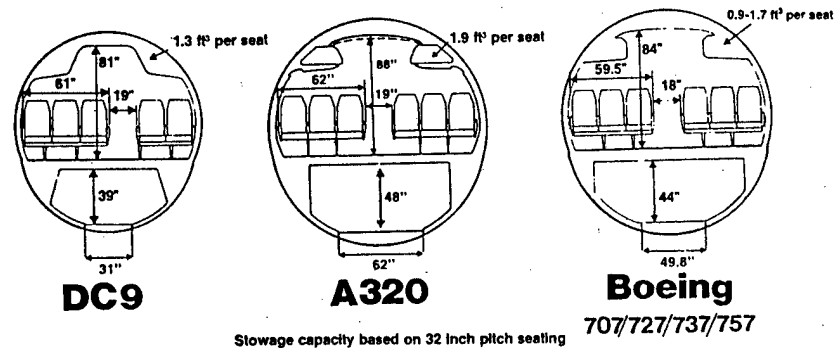
3  
 2 B4-200 = commande Air Jamaica du 8.I.1982  
 2 A 310 = unannounced company  
 3 A 310 = unannounced company

Key: 1--Firm; 2--Converted options; 3--Order form.

## Expanding the product line



## A320 cross section comparison



The A320 provides distinct marketing advantages necessary for an aircraft intended for service into the 1990s.

- wider seats
- greater adaptability
- more carry-on capacity
- improved underfloor features

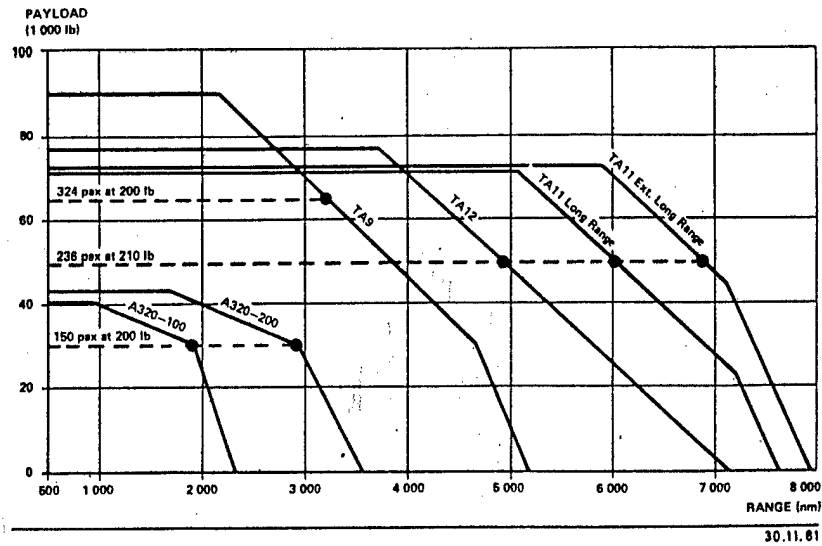
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## Payload range comparison

Range with full pax and baggage (mixed class)

All Standard OWE's, FAR domestic reserves for A320-100/200 and TA9

FAR international reserves for TA11 and TA12:



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## TRANSPORTATION

### SWEDEN USES ADVANCED TECHNOLOGY IN CONSTRUCTING SF 340

Stuttgart FLUG REVUE in German Jun 82 p 61

[Article by Hans Redemann: "Ultra-Modern Aircraft Engineering"]

[Text] Sweden is beginning the production of the new commuter aircraft by Saab and Fairchild. It will be a technical delicacy with a glued airframe and the most modern electronic equipment.

After detailed market studies, the manufacturing firms Saab-Scania of Sweden and Fairchild of the United States in June 1979 decided on the joint development of a twin-engine commuter aircraft in the weight category of around 10 t. The contract was signed and the attendant decision on the project definition phase for the new aircraft under the designation SF 340 took place just 6 months later.

Depending upon the load, it is designed for ranges of up to 3,200 km. Its maximum passenger capacity is 34 and the passengers are seated in a pressurized cabin with variable interior furnishings and an aisle height of 1.82 m. The SF 340 was designed for a lifetime of 45,000 flying hours.

After longer decision preparations, the designers in June 1980 selected 2,177-kw turboprops of the General Electric CT7-5 type as the power plant; they are supposed to help the SF 340 to attain a cruising speed of about 500 km/hr. This engine proved to be superior to other engines. It was derived from the T700 helicopter engine and according to reports from General Electric, the fuel consumption of the CT7-5 is almost 20 percent less than that of the comparable engines in its performance class.

In selecting the airscrews, the design team settled on a four-blade propeller in the composite [sandwich] design which was developed by Dowty Rotol. With the help of a novel gear, this automatically adjustable propeller, with a diameter of 320 m, turns at only 1,380 rpm. A correspondingly modified Gulfstream I has been picked as the flying test stand for the SF 340 engine. The fuel system consists of two, each, integral containers in the wings with a capacity totalling 3,330 liters.

The SF 340 program has made considerable progress since the start of work. After the first order was received in November 1980, Saab-Fairchild now has



60 firm orders and options. The first operator will be Crossair, a Swiss regional company, which has ordered 10 aircraft alone. But several American commuter airlines are also on the customer list. The basic version of the SF 340 presently costs \$4.75 million.

The production of the first of two model aircraft has been started at Saab in Linköping. The rollout is scheduled for November of this year and it is to go into flight testing early in 1983. Licensing for the United States and Europe will also come through during that year so that one can expect the delivery of the first series-produced aircraft early in 1984. A completely new shop complex was erected for the production of the SF 340 in Linköping at a cost of 200 million Swedish Crowns (DM80 million). This plant is currently already gluing complete side shells for the center section of the fuselage with longitudinal profiles and window frames and they are being prepared for series production.

Commuter air travel undoubtedly will get new impetus from the highly promising Saab-Fairchild 340. Its direct competitor models are not only the EMB-120 Brasília and the French-Italian AS 35/AI T 230, but also the Dash 8 of de Havilland of Canada.

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## TRANSPORTATION

### BRIEFS

METHANOL-POWERED COMMERCIAL VEHICLES--Frankfurt, 25 May--Five heavy city cleaning trucks were equipped with a methanol engine for the first time in Berlin. Half a year ago already, six VW vehicles of the Berlin City Cleaning Enterprises were converted to that same type of motor. In this way, the Berlin City Cleaning Enterprises are continuing their series of experiments to test environmentally safe drive methods which began in 1977 with the equipment of two vehicles with electric motors. The engines of the newly commissioned Magirus-Eutz/Iveco trucks were developed by Kloeckner-Humboldt-Deutz AG [Incorporated] as part of a project promoted by the Federal Ministry of Research and Technology. The Department of Applied Thermodynamics of the Aachen Technical College was also involved. In this process, a series-produced diesel engine was converted for operation with methanol and it is hoped that this will result in extensively soot-free and odorless operation. The decisive characteristic of this engine is the pilot injection method where a small quantity of diesel fuel is sprayed directly as ignition oil from an accessory spray unit into the combustion chamber of the engine shortly before the methanol quantity. The ignition oil is ignited as in the conventional diesel engine by the compression heat and thus causes the subsequently injected methanol to explode, according to a report from Iveco. Methanol, as an alternate fuel, is obtained mostly from coal and natural gas. But it can also be made from wood, plants, or urban waste. Because the community-owned vehicles, as in the case of Berlin, operate from certain yards or dumps, it would not be necessary to build up a major network of gas stations for methanol. [Text] [Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 26 May 82 p 5] 5058

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END